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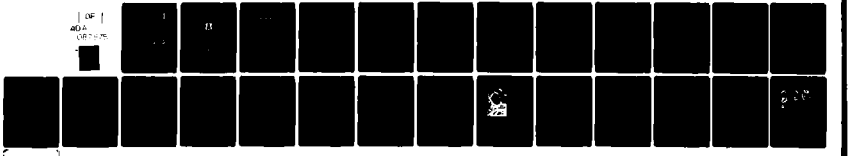

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U. S. BOARD ON GEOGRAPHIC NAMES TRANSLITERATION SYSTEM

Block	Italic	Transliteration	Block	Italic	Transliteration
А а	*А а*	A, a	Р р	*Р р*	R, r
Б б	*Б б*	B, b	С с	*С с*	S, s
В в	*В в*	V, v	Т т	*Т т*	T, t
Г г	*Г г*	G, g	У у	*У у*	U, u
Д д	*Д д*	D, d	Ф ф	*Ф ф*	F, f
Е е	*Е е*	Ye, ye; E, e*	Х х	*Х х*	Kh, kh
Ж ж	*Ж ж*	Zh, zh	Ц ц	*Ц ц*	Ts, ts
З з	*З з*	Z, z	Ч ч	*Ч ч*	Ch, ch
И и	*И и*	I, i	Ш ш	*Ш ш*	Sh, sh
Й й	*Й й*	Y, y	Щ щ	*Щ щ*	Shch, shch
К к	*К к*	K, k	Ъ ъ	*Ъ ъ*	"
Л л	*Л л*	L, l	Ы ы	*Ы ы*	Y, y
М м	*М м*	M, m	Ь ь	*Ь ь*	'
Н н	*Н н*	N, n	Э э	*Э э*	E, e
О о	*О о*	O, o	Ю ю	*Ю ю*	Yu, yu
П п	*П п*	P, p	Я я	*Я я*	Ya, ya

*ye initially, after vowels, and after ъ, ь; e elsewhere.
When written as ё in Russian, transliterate as yё or ё.

RUSSIAN AND ENGLISH TRIGONOMETRIC FUNCTIONS

Russian	English	Russian	English	Russian	English
sin	sin	sh	sinh	arc sh	$\sinh^{-1}$
cos	cos	ch	cosh	arc ch	$\cosh^{-1}$
tg	tan	th	tanh	arc th	$\tanh^{-1}$
ctg	cot	cth	coth	arc cth	$\coth^{-1}$
sec	sec	sch	sech	arc sch	sech^{-1}
cosec	csc	csch	csch	arc csch	csch^{-1}

Russian	English
rot	curl
lg	log

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Opening the era of jet aviation....

During December are fulfilled 50 years from the day of the creation of the Central aerohydrodynamic institute (TsAGI [Central Institute of Aerohydrodynamics im. N. Ye Zhukovskiy) im. N. Ye. Zhukovskiy. It is difficult to overestimate the value of TsAGI in the development of Soviet aviation and aviation sciences in general/common/total scientific progress. They were necessary the genius of our Party and its great leader of V. I. Lenin in order under the difficult conditions of 1918 not for minute not to forget about the future of Soviet science. Creation of TsAGI - is a clear example of this.

However, from the first days of its existence TsAGI was personified by the synthesis of science and technology. It was organized not simply as institute for aerodynamics, but also as complex scientific center for the practical resolution of the problems of aviation. One ot primary tasks of institute was the creation of the scientific bases of aviation, i.e., the development

of three main sections of applied mechanics - aerohydrodynamics, strength and dynamics of flight venicles.

Much made scientific TsAGI for perfection and development of aviation technology in pre-war years and in the period of great Soviet war. Were solved the most important problems of an increase in the maximum speeds of our combat aircraft, improving of their maneuverability, stability and controllability, flight safety.

Reaction turned to the corresponding member of the Academy of Sciences of the USSR Georgiy Sergeyevich Byushgens and professor, doctor of technical sciences Rafail Ilyich Shteynberg with request to describe about one of the brightest pages into the history of TsAGI, connected with the development of the ideas of reactive motion and their subsequent implementation into aviation equipment.

An increase at the end of the Great Patriotic War of the maximum speeds of the flight of piston-engined aircraft was achieved by the value of a very large increase in the required powers of engines. The principle of the retention/preservation/maintaining the permanent power, inherent in piston engine, was obstruction for further increase in the flight speed. Resulted from this on the incidence/drop in the effective thrust on speed. This is why already in the beginning of the fortieth years in TsAGI and in other

scientific organizations are the works in which is based the advisability of using for aircraft of different schematics of the air-breathing and rocket engines, making it possible to preserve with an increase in the velocity of virtually constant thrust or even to increase it. This was fundamentally new direction in aeronautical development, it offered enormous possibilities for a rapid increase in the velocity of flight.

Soviet scientists began to carry out the large number of investigations, directed toward the study of the compressibility effect of air, since velocities greatly rapidly approached the speed of sound.

Let us note that even in the beginning 900-x of years S. A. Chaplygin in the work "about gas jets" placed the foundation of gas dynamics - the new section of aerodynamics, examining flow with large ones to velocities. In the 30th and 40-x years this section of aerodynamics underwent considerable development.

High-speed aerodynamics began to be successfully developed because of creation and introduction to the system in TsAGI of variable-density wind tunnel with large subsonic Mach numbers. At that time it was the unique experimental installation, which exceeded according to sizes/dimensions and characteristics similar foreign

installations.

The large complex of experimental and theoretical studies in high-speed aerodynamics made it possible to establish/install the series/row of the most important laws. On this scientific base became possible the aerodynamic design of wing and other elements/cells of aircraft, designed for transonic speeds. So was given the refined method of determining the critical Mach number, were established/installed laws governing the increase of the resistance of profile/airfoil with supercritical Mach numbers and possibility of the appearance of resistance besides the wave, caused by separation from under shock wave. With the aid of experiments was revealed/detected the incidence/drop in the maximum lift of profile/airfoil with an increase in the Mach number. Scientists established/installed corrections for the compressibility effect of air to induced velocities.

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This made possible to consider compressibility effect in the airfoil theory of final spread/scope.

In the region of near-critical Mach numbers by the scientists of TsAGI was opened the "law of the stabilization" of local Mach

numbers. Its essence lies in the fact that mach-number distribution in the local limited supersonic zone remains in effect permanent, in spite of a change in the velocity of incident flow. This law made it possible to explain the specific character of a change in the power and moment air foil data with Mach numbers larger than critical ones.

Were established/installed laws governing interaction of fields from the coupled elements/cells of aircraft, which composed basis for the resolution of the problem of aerodynamic interference.

All this made it possible to develop the scientifically substantiated methods of designing the transonic aircraft.

At TsAGI were created series of high-speed/velocity profiles/airfoils. They possessed high aerodynamic cleanness. Subsequently all wings of Soviet aircraft began to be composed only from such profiles/airfoils.

. The large/coarse event, which expanded the possibilities of the study of transonic flows, was creation and launching/starting in TsAGI in 1947 of wind tunnel with perforated walls in test section. For the first time in the world they began to carry out tests with continuous transition/transfer through the speed of sound. In common tubes this is impossible as a result of the "blocking" of flow

(in the presence of model) with numbers M=0.85-0.9.

The investigations by TsAGI showed that the most effective means of further decrease of wave wing drag - use of an effect of slip and decrease of the maximum thickness of its profile/airfoil. However, on structural/design reasons the possibility of decreasing the wing chord ratio of great lengthening is extremely limited. Therefore the development of this direction was connected with low-aspect-ratio wings. Furthermore, to straight-wing airplane of great lengthening it is difficult to ensure stability and controllability. Moreover, it is not excluded its tightening into dive at high velocities of flight.

Imparting to wing sweepback made it possible to increase the range of flight mach numbers. The sweep effect leads also to the decrease of the intensity of a change in all aerodynamic characteristics upon transfer through the speed of sound.

The investigations in the region of aerodynamics and dynamics of aircraft for transonic speeds, carried out in TsAGI, were that foundation on basis of which was created the series/row of combat and passenger jet aircrafts with the sweptback wings for this speed range.

In the stability region and controllability for transonic

aircraft also arose new problems. They successfully were solved in TsAGI. So were developed controls, ensuring high effectiveness in entire speed range. Is investigated compressibility effect on the characteristics of longitudinal and lateral stability. Was discovered and explained the phenomenon of the reversibility of the moments of roll with the slip of aircraft with the sweptback wing. Are found basic principles and is introduced the first reversible, and then fully powered controls. Are developed the methods of estimating spin and are created reliable criteria according to the evaluation of the steady modes/conditions of spin and methods of removal. Large role began to play the dynamics of the yawing motion of aircraft. In TsAGI are created the methods of calculation of the lateral disturbed motion and the criteria of its evaluation.

Thrust augmentation of the turbojet engines at high velocities and use of the sweptback wing created real possibilities for the rapid development of supersonic aviation. So, as long ago as 1952 on aircraft MIG-19 was for the first time achieved/reached the velocity, considerably exceeding sonic. However, the problem of the creation of flight vehicles with supersonic speeds required the intense research work of the scientists of TsAGI in the region of aerodynamics and dynamics.

At the end of the fortieth and in the beginning Fifties in TsAGI

entered the system supersonic wind large-size tunnels. The creation of these tubes rested on the previously accumulated experience and the essential results of theoretical and experimental studies in the region of internal supersonic flows, studies of nozzles and diffusers.

The development of supersonic aviation required resolution of many urgent theoretical problems - series of problems by the airfoil theory of final spread/scope in the supersonic flow, the developments of the approximation method of the flow-field analysis of fuselages and housings. With the aid of variation principles the scientists of TsAGI solved tasks in finding of the optimum aerodynamic shapes of wing and fuselage and their combinations. Considerable attention is given to the theoretical and experimental methods of decreasing the resistance from interference in the region of coupling of wing and fuselage, wing and engine nacelles.

In the wind tunnels of TsAGI are carried out wide experimental investigations. Is continued the study of the aerodynamic properties of wings with different sweepback. Are investigated the possibilities of reducing/descending in the wave drag and increase in the lift effectiveness of the layouts of different diagrams.

The basic and most effective method of reducing/descending the wave drag at supersonic speeds consisted in an increase in the sweepback of wings and the decrease of thickness ratio. Simultaneously with the sweptback wings began to be examined trapezoidal low-aspect-ratio wings (so-called diamond wings), and then delta wings with smaller thickness ratio.

Considerable efforts were directed at the experimental check of theoretical positions about the possibility of decreasing the resistance, caused by lift, via the realization of the effect of suction force with the subsonic leading edges of wing. Were obtained the positive results, which gave the noticeable decrease of resistance, especially with the use/application of special strain of the leading edge, the so-called conical twist.

The development of supersonic aviation was inseparably connected with the perfection of aerodynamics of power plants. Vital importance for an increase in velocity and flying range had creation of special supersonic diffuser for the channels of jet engines. In common type diffusers the conversion of the supersonic flow in subsonic occurs in normal shock wave and is accompanied by considerable losses of pressure. In TsAGI and other NII [Scientific Research Institute] were

developed the methods of construction of the diffuser, in which supersonic speed is braked in the optimum system of oblique shocks. The system of oblique shocks is created with the aid of special cones and wedges, leading into diffuser.

The frontal uncontrolled air intakes with cone were the first space in the resolution of the problem of stagnation of supersonic flow before the engine. Further with an increase in the flight mach number arose need in the adjustable intake systems, since for the larger range of Mach number it was not possible to create the geometry of entry, ensuring high effectiveness both according to the pressure recovery factor during braking and on least possible wave drag.

Investigations by choice of the wing, which has high lift-drag ratio, substances contemporary aircraft construction are conducted in two directions. The first is connected with the use/application of thin low-aspect-ratio wings with fractures on leading edge or with the edges of curvilinear contour.

The second direction is connected with the use/application of wings of the variable in flight geometry with the rotation of arms. Characteristics in takeoff and landing modes/conditions due to low sweepback and great lengthening in this case considerably are

improved. With the aid of optimum wing setting at subsonic cruising flight speed it is possible to substantially increase flying range. Wing setting to the angle of very large sweepback facilitates the conditions for transition/transfer to supersonic velocity and low-altitude flight.

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An increase in the power-weight ratio of contemporary aircraft contributed to the appearance of a new direction in aeronautical development. Are developed/processed VTOL aircraft. The creation of this type of aircraft required the resolution of number of problems in the region of aerodynamics and dynamics. Most essential of them is interaction of the vertical jet of lift engine with the flow around of the wing and entire aircraft, especially near the earth's surface.

For explaining this effect in TsAGI were carried out vast theoretical and experimental studies.

The creation of supersonic aircraft required the solutions of the series/row of fundamental questions in the stability region and controllability.

One of the most important questions was the guarantee of

longitudinal static stability at high angles of attack. Transition/transfer to supersonic flight speeds was connected with considerable displacement back/ago along the chord of mean aerodynamic center of wing. This required the increased effectiveness of horizontal tail assembly. The scientists of TsAGI proposed to pass on by pillar the moving surface of stabilizer - controllable stabilizer.

The layout of supersonic aircraft, besides changes in their geometry (thin wing, low wing aspect ratio, pointed slim fuselage, etc.), was connected also with considerable ones with a change in inertia characteristics. As a result of careful study in TsAGI was discovered the possibility of loss of stability with sharp rolling as a result of inertia interaction of longitudinal and yawing motion. Was developed theory of this question, were shown the measures, removing this danger.

The very important direction of the investigations by TsAGI was also work along control systems by supersonic aircraft. There was is widely used fully powered controls with the regulation of the basic kinematic parameters of the system of control and parameters of the system of the imitation of efforts/forces (loads) during control.

Wider use found other elements/cells of the automation of

control - vibration dampers of aircraft, automatic pitch control systems of isodromic type, giving the possibility to obtain the fundamental handlings, not virtually depending on flight conditions, the center-of-gravity location and other parameters.

The development of supersonic aviation required further improvement of the methods of calculation of flight-performance data and creation of procedures of the selection of optimum flight conditions.

The permanent progress of flight vehicles led also to the need for the investigation of questions of aerodynamics and dynamics of aircraft with all high supersonic velocities.

The theory of hypersonic flows was created and widely developed to a considerable degree by Soviet scientists. Prerequisites/premises for its rapid development were laid even in the period of the formation of aerodynamics of the moderate supersonic velocities.

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In the process of the development of these investigations in TsAGI intensely was improved experimental base and were created the gas-dynamic installations, designed for more supersonic Mach numbers.

The emergence of diverse gas-dynamic installations for the hypersonic investigations of very short-term action required sufficiently large efforts for development and creation of highly sensitive measuring equipment, satisfying stringent requirements in frequency and value of the measured values. Transition/transfer to high supersonic flight speeds - hypersonic (M=5-6 and more) considerably complicated the investigations of the problems of aerodynamics. For the solution of the problems about the flow around body became necessary the enlistment not only of thermodynamics, but also chemistry, but in the series/row of cases and theory of electromagnetic field.

One of the complex problems of aerodynamics and dynamics of hypersonic flight vehicles - adjustment of the forms of apparatuses, whose braking velocity is accomplished/realized without the use of lift. It turned out that the most rational form - is the blunted bodies, ensuring substantially smaller heat fluxes.

Is the following most important of tasks - study of the shapes of the bodies, which possess low lift-drag ratio. The development of such forms required new investigations in aerodynamics and dynamics of bodies with lift and in the large range of angles of attack,

including the modes/conditions of breakaway.

Further investigations showed that the creation of the hypersonic flight vehicles, possessing the high values of lift-drag ratio, makes it possible to considerably expand the region of their use/application, to give to them maneuverability and properties of autonomous landing. In entire speed range of flight, including landing attitude, it is necessary to ensure high values of lift-drag ratio, the acceptable heat fluxes (which is connected with the large bluntings of leading edges), good stability characteristics and controllability.

Together with flight vehicles are created the conditions also for the development of the hypersonic aircraft of different classes.

Study and development of separate elements/cells and entire layout of this aircraft - one of the most important tasks of contemporary aerodynamics and dynamics.

Because of the concerns of the Communist Party and Soviet government, TsAGI became the most important institute, ensuring the steady progress of aviation equipment.

Many memorable cases exists in the life of Yevgeniy Korsakov. Repeatedly it was necessary to land on unknown airfields, to fly in southern and north latitudes. However, his and the crewmembers' experiences in their last training sessions are out of the ordinary. "Its' almost like combat," said the navigator after touchdown. Landing with weather minimum on unknown airfield it was necessary to fulfill with switched-off ground radio engineering

equipment. In the photograph: the military pilot of the first class Major Ye. Korsakov.

G. Byushgens, associate member of the Academy of Sciences of the USSR

R. Shteynberg, professor, doctor of technical sciences.

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TsAGI - 50 years.

COMMEMORATIVE MEDALS.

First December of 1918 was created one of the first scientific research institutions of the country - central aerohydrodynamics institute.

The spirit of TsAGI from the moment/torque of its base/root and to the end of his life was the "father of Russian aviation" - Nicholas Yegorovich Zhukovskiy Shortly, the institute became the leading organization, which ensured the fast progress of Soviet aviation. Series of affected question grew literally in front of one's eyes. And TsAGI generously singled out a number of the new directions, for example, of aviation science of materials, aviation motor building.

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Are created independent scientific research institutes.

At its 10th anniversary TsAGI arrived with great successes. In the country was fixed the series production of all-metal aircraft. On mark in the honor of 10th anniversary is depicted the worker, that give start in life to next aircraft. Are visible the buildings of institute and the famous tower of wind-driven laboratory.

1933 marked the 15th anniversary of TsAGI. This was the time when entire/all country participated in the construction Flagman of the agitation squadron - aircraft "Maxim Gor'kiy". The largest and peace/world overland aircraft was created in design bureau of A. N. Tupolev. On mark against the background of the flag of land of the Soviets flies eight-engine Ant-20 "Maxim Gor'kiy". Author marks "10th" and "15th" anniversaries of TsAGI - B. M. Kondorskiy.

The 50's can be named/called the years of the formation of jet aviation. In 1956 to the line of Aeroflot left the first in the world passenger jet aircraft of Tu-104. Were improved combat vehicles. On mark in the honor of 40th anniversary of TsAGI we see the fast taken away upwards jet aircraft. It passes already 10 years. In all areas of aviation technology they will achieve new progress. The result was the aircraft Tu-144, supersonic passenger liner.

Is strict and laconic mark in the honor of 50th anniversary of institute. Roman numeral of "L" intersects the profile/airfoil of

TsAGI. Two dates - 1918-1968.

To 50th anniversary, besides mark, Moscow mint it engraved anniversary medal from the bronze with a diameter of 70 mm. On face is depicted the founder of TsAGI - professor N. Ye. Zhukovskiy, who stands at working table. The central part of opposite side is occupied with supersonic aircraft. Below label into nine lines: "The central aerohydrodynamic institute im. professor N. Ye. Zhukovskiy is based 1.XII.1918". Autnor of mark and medal T. Yegorov.

Let us wish to the leading scientific center of aviation thought of further successes in the development of the air fleet of the USSR.

M. Saukke.

Key: (1). The central aerohydrodynamic institute im. professor N. Ye. Zhukovskiy was founded on 1 December 1918